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METALIUM[1]

By Homer V. Knouse

The industrial progress of the United States has been due not only to the inherent enterprise of Americans, but almost equally to their readiness to put aside old methods and try new processes. This has been true particularly in connection with concentrated industries commanding large capital and corresponding profits. In such cases, under intelligent management, new ideas have been not only welcomed but experimental work encouraged notwithstanding the uncertainty of results and the expense involved, which in many instances has been enormous.

However, there are certain industrial processes that have been unaffected by this spirit of progress, that are utilized today just as they were fifty years, even a hundred or more years ago. Examples are those used here and there in construction work, mostly simple in character and while far from ideal, yet not unsatisfactory. Such processes have thus persisted largely as the result of habit, and the absence of the incentive of material financial gain, which alone seems capable in the industrial world of overcoming the inertia of habit and compelling the adoption of improved methods.

One of these unimproved processes is the use of lead for jointing bell-and-spigot water pipe. This practice was in vogue more than a century ago, and the method remains practically unchanged to this day, even to the use of a mud or clay roll as a joint runner, which still persists in many instances. It is true that lead makes a very satisfactory joint when properly run and calked, but the material and method are far from ideal. First, lead is relatively expensive, hence the loss from oxidation and scattering is material; also being readily saleable, it is subject to theft. Second, for melting, it requires a relatively high degree of heat, often resulting in over-heating and hence oxidation. Third, if not hot enough it cools before the joint is entirely filled, and, in spite of calking, the joint will ultimately leak. Fourth, its handling is not without danger because of its weight and the liability of explosion in case of wet joints. Fifth, a lead joint must be calked and the calking should be done by a reliable, skilled mechanic, otherwise a bell may be ruptured, and here and there the bottom of a joint neglected because of the difficulty of getting at it. Skilled calking is constantly growing more expensive, in some localities the wage demanded being as high as 55 cents per hour, with a limit on the number of the joints for a day's work. Unskilled calking means an unsatisfactory job, sooner or later. Sixth, calking requires the digging of bell holes which adds to the cost of excavation. Seventh a leak in a lead joint will persist; it will not decrease automatically but it increases with time.

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[1] **Read before the Iowa Section on October 10, 1917.**

In view of the shortcomings of the lead joint, the management of the Omaha water plant, some years ago, began seeking a substitute for lead, and as result, experimented with a metalloidal composition or alloy known as metalium. The advantages claimed for this material are the following:

1. Low cost. To compete with metalium as a joint filler lead would have to sell at approximately 2 to 2½ cents per pound.

2. Low melting temperature. This is a little more than one-third that of lead, resulting not only in a saving of fuel but also eliminating all danger from explosion in pouring a wet joint.

3. A relatively high specific heat. This insures with greater certainty the complete filling of a joint, and enables joints to be poured successfully at a considerable distance from the melting pot.

4. A low specific gravity. This is about one-fifth that of lead. Thus a man can easily handle a bucket of molten metalium sufficient to run a 48-inch joint.

5. No calking required. This eliminates the expense of calkers and the digging of bell-holes and also materially expedites the work of installing pipe lines.

6. The automatic closing of leaks developing in metalium joints. Initial leaks gradually close and those due to subsequent settlement of pipe eventually terminate likewise.

After a number of trials, it was concluded that these claims were substantially justified, and metalium has been utilized, to the exclusion of lead, in the installation of all pipe lines within the Metropolitan Water District for the past four years or more. In fact, a carload of lead purchased early in 1913 was subsequently sold at war prices, thereby netting the District a handsome profit.

Joints of all sizes of pipe have been run, from 3 inches to 48 inches in diameter, and during the period in question in the neighborhood of fifty miles of pipe lines have been installed in the Water District, subject to pressures as high as 115 pounds, using metalium alone as the jointing material. In the care of pipe of larger diameters than 24 inches, however, a bestolyte lining is inserted before the metalium is poured.

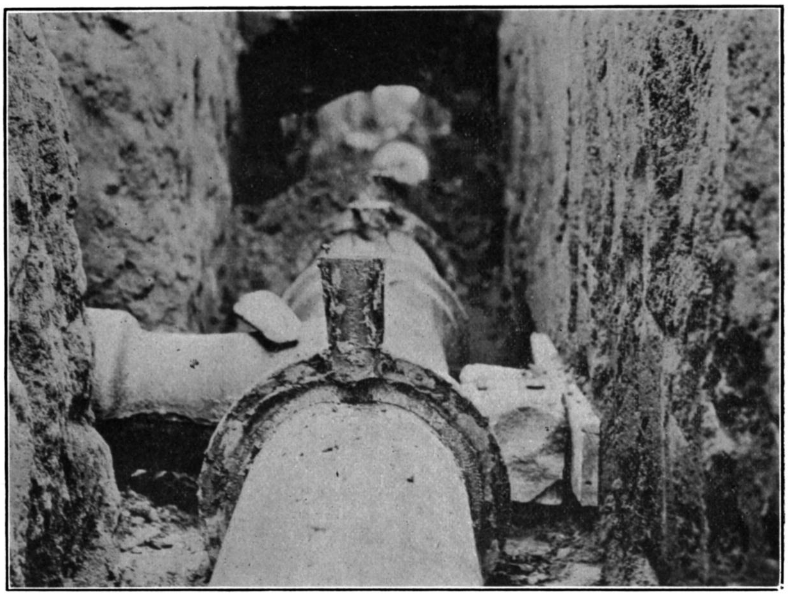
In view of these facts, it would seem that metalium should supplant lead in the installation of water mains under ordinary conditions, and that too, notwithstanding the inertia of habit, as the saving per mile of pipe in comparison with the use of lead, at 13 cents per pound (the quoted price of lead when these calculations were made) is approximately as follows:

Diameter of pipe, inches	6	12	24	48
Saving per mile	$565	$993	$2415	$5160

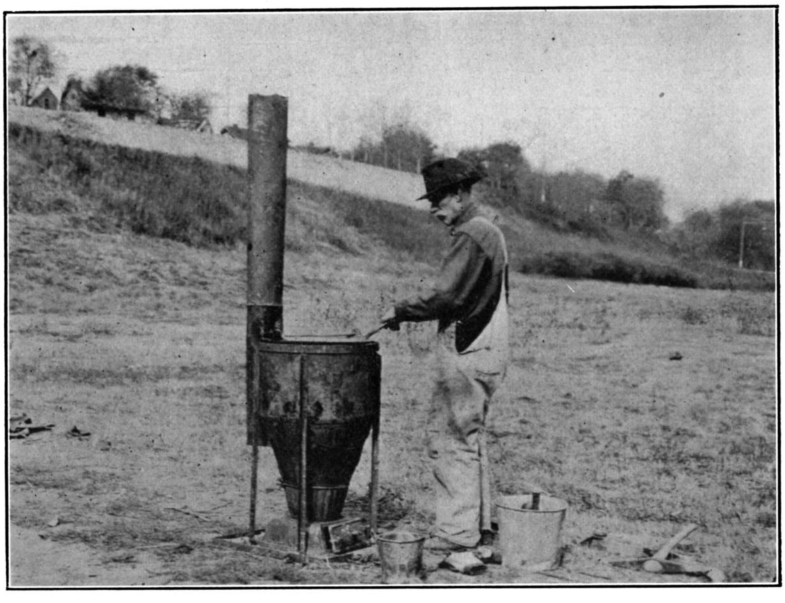
While metalium possesses a number of advantages over lead as a jointing material, yet its adoption entails one disadvantage that should be realized and understood by any one contemplating its use. This disadvantage consists in the initial leakage that often takes place in metalium joints when the water is first turned on. In a lead joint, this leakage is obviated by calking, while in the case of a metalium joint, the pressure is left on with the result that calking is accomplished automatically, it being simply a matter of time. This self-calking is not merely an accidental result, experience having demonstrated it to be positive and certain in character.

Although this disadvantage, therefore, is apparent rather than real, it can readily constitute a real obstacle to the adoption of metalium in the mind of one contemplating its use, due to the fear that such initial leaks will not close. However, experience soon dissipates this fear and begets full confidence, so that ultimately there is no hesitation to cover a pipe line as rapidly as joints are run, which is unvarying practice in the Metropolitan Water District.

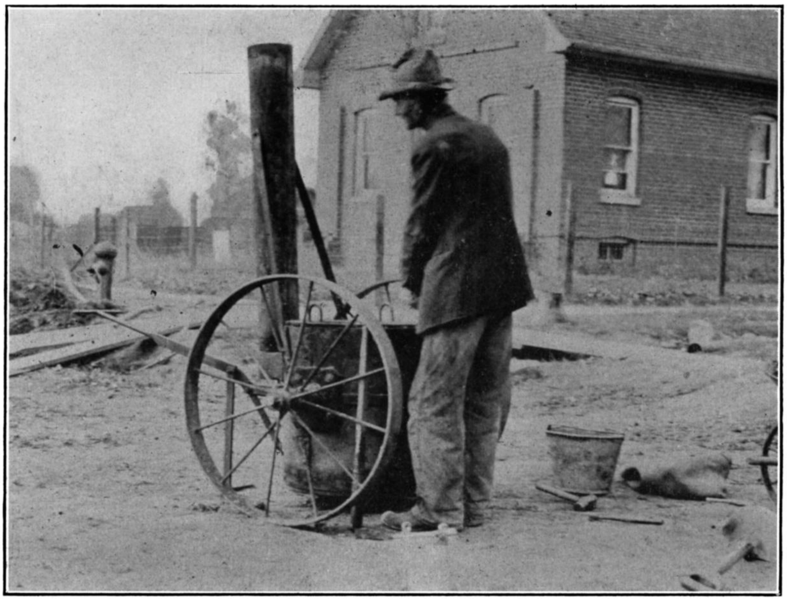
The following test illustrates this self-calking quality: After a newly laid pipe line was filled, the valves at each end were closed, and the line supplied with water through a $\frac{5}{8}$ inch meter. The first reading indicated a leakage of 1790 gallons per mile in twenty-four hours per inch of diameter of pipe; two days later this leakage was 564 gallons; five days later it was 174 gallons; one day later 139 gallons; two days later 115 gallons; three days later 85 gallons, and at



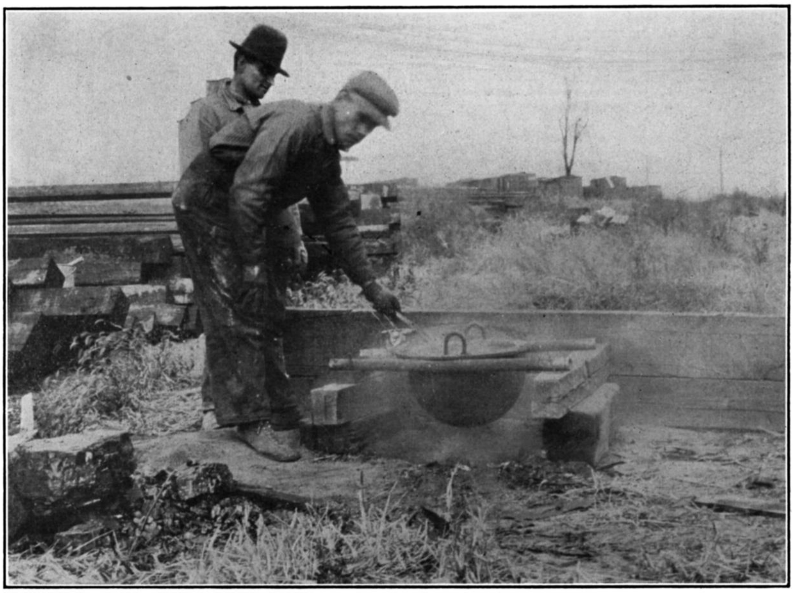
Completed Metalium Joint before the Gate has been Broken Off



Metalium Furnace



LEAD FURNACE CONVERTED INTO METALIUM FURNACE BY REDUCING GRATE AREA TO AN 8-INCH CIRCLE



MELTING METALIUM OVER AN OPEN FIRE ON A SMALL JOB a subsequent reading of the meter, the line was practically tight. In this connection it should be remembered that authorities are not wanting that decree a lead jointed pipe line tight when the leakage does not exceed 300 gallons upon the same basis of measurement. A mile of 24-inch pipe, which showed a considerable initial leakage when first put into service, was subsequently tested and found to be practically bottle tight.

Again, the accounting department of the Metropolitan Water District affords monthly statements of water passing through all consumers' meters, and these statements show that more than 83 per cent of the water supplied to the city of Omaha (Venturi meter measurement) is accounted for through such consumers' meters, and this notwithstanding the fact that there are still about 500 flat-rate services in use and some 600 sewer flush tanks unmetered. The estimated water used by these unmetered services, together with that used in building, for street flushing and sprinkling, the flushing of sewers and water pipe trenches, and the water required for fire service, is estimated at 5 per cent, thus making the total water accounted for 88 per cent of that supplied to the District. When it is remembered that some water systems cannot account for more than 60 per cent of the water supplied, it suggests that the mains of the Metropolitan Water District are reasonably tight.

Metalium is of a dark greyish luster, and is supplied commercially in globular form, put up in bags of 100 pounds each. In use, it is melted and poured just as in the case of lead. However, while the temperature of molten lead when poured is immaterial, in the case of metalium the temperature is important; it must not be too hot. It is not difficult to tell when metalium is ready to pour, as it is then a thin, nearly black, oily appearing liquid. If too hot, molten metalium is inclined to thicken and does not pour readily. The difficulty of firing the ordinary lead furnace so as to limit the temperature renders it unsuitable for metalium. However, if the grate area of such a furnace is choked down with fire brick and clay so as to leave the open surface but 8 inches in diameter, such a furnace can be utilized. But the best plan is to secure the specially designed metalium furnace, as it is light, cheap, and admirably arranged for temperature control. It is surprising the small amount of fuel required—either coal or wood. In the Water District work old discarded lumber is chopped up for this purpose.

Furnaces using oil or gasoline are also satisfactory but are difficult to keep going in a high wind. It is very important that the bell and spigot of the joint to be run should be thoroughly clean and free from oil or grease. For this reason unoiled jute yarn, only, should be used for packing. Tarred yarn or yarn that is not free from oil or grease must be avoided. As a matter of fact, practically all initial joint leakage can be obviated if particular care is exercised in cleaning and keeping clean, each bell and spigot, using a putty knife to remove all lumps and blisters in the pipe coating. One of the Water District's most successful foremen does this, and after the joint is yarned, he inserts a loose strand of yarn so as to keep the joint free from dirt until poured, a practice that will be found highly profitable in connection with lead joints.

Any form of joint runner can be utilized, smearing it with wet clay before placing it around the pipe. The gate must be made larger than for lead and should be at least 6 to 8 inches high above the spigot. In the Metropolitan Water District work, clay is the material used for making gates in jointing pipe. In this connection, a round wooden gate peg is very useful. This peg is conical in form, 10 inches long, 2 inches in diameter at the bottom, and 3 inches at the top. The bottom of the peg is inserted between the ends of the joint runner where they come together to form the gate, then clay is built up about this peg, which is then turned around once or twice and withdrawn leaving a well formed gate of the right height.

The metalium gate buttons can be remelted, but it is important that they should be thoroughly cleansed and broken up before being put back in the melting pot.

From the foregoing, it is evident that the technique of this jointing material is simple, and it can be easily mastered by the ordinary workman; moreover, when faithfully carried out, it will afford highly satisfactory results. However, it should be remembered by those contemplating the use of metalium, that they will arouse the resentment of calkers, for the very good reason that the adoption of this material means their practical elimination. This was the experience in Omaha. Every calker at once insisted that metalium was a failure, and tried to make it a failure, even going so far as to throw dirt surreptitiously into the joints ready to pour. Failing in this, they sent their friends to the Water Board with warnings as to the dangerous innovation that was being attempted. All this, now, of course, is past and gone, so far as the Metropolitan Water District work is concerned, but others attempting to use this material will probably meet with the same experience, as human nature is the same the world over.